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# Issue

## *The Contribution of Urban Activities to the Deterioration of the St. Lawrence River*

### *The State of the St. Lawrence River*

**Saint-Laurent**  
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Urbanization and its associated practices have major repercussions on the natural environments and on the various uses of the St. Lawrence River. Indeed, urban activities constitute one of the main sources of pressure on the St. Lawrence. The 334 St. Lawrence riverside municipalities are home to more than 60 percent of the entire population of Quebec. Metropolitan Montreal has over 50 percent of the population of Quebec and more than 43 percent of its industrial and commercial plants. Over the past few years, the rate of urbanization in Quebec has outpaced population growth.

This fact sheet identifies the main sources of pressure resulting from urban activity and its effect on the state of the St. Lawrence River, presenting the main initiatives undertaken to safeguard the River while maintaining its uses and resources from a sustainable development

perspective. For further information and a more in-depth analysis of the problem, the reader may refer to the reports listed at the end of the fact sheet.



# Sources of Pressure

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The process by which urban activities put pressure upon the various components of the natural environment is complex. To assess the impacts of urbanization on the St. Lawrence River, urban activities were divided into three main categories based on the type of pressure. They are as follows:

- Water supply services.
- Urban effluents, including: discharges of treated and untreated wastewater, overflows of sanitary and storm sewers, surface-water runoff and snow dumping.
- Physical modification of the riparian environment.

Different analytical criteria were considered to deal with these pressures. One of the most important criteria in terms of urban-source pressure is geographic scope. Land-use patterns and the concentration of certain urban activities will thus determine the intensity of the pressure.

In the St. Lawrence, the pressures associated with urban activity are greatest in the Fluvial Section and the Fluvial Estuary, particularly

pressures related to water supply services and the discharge of urban effluents. The reasons are simple: the high population density in these river sections and the fact that water intakes are located solely in fresh water. Riverside residents draw large amounts of water from the River, but they also release to it equally large volumes of wastewater. The St. Lawrence supplies water to more than three million people, or 43 percent of the population of Quebec. The volume of water drawn from the Fluvial Section and Fluvial Estuary totals 2 930 288 cubic metres (m<sup>3</sup>) per day. Lake Saint-Louis is the single biggest source of this water, supplying 1 706 202 people, most of whom live on the Island of Montreal. Moreover, 70 percent of the load of household contaminants is released to the Fluvial Section, with the Montreal Urban Community alone responsible for 57 percent of the water requiring treatment in Quebec. The greater spread of urban activity has also played a determining role in the physical modification of the riverbanks. The potential artificial modification of the banks is thus quite high in the Fluvial Section and the Fluvial Estuary.

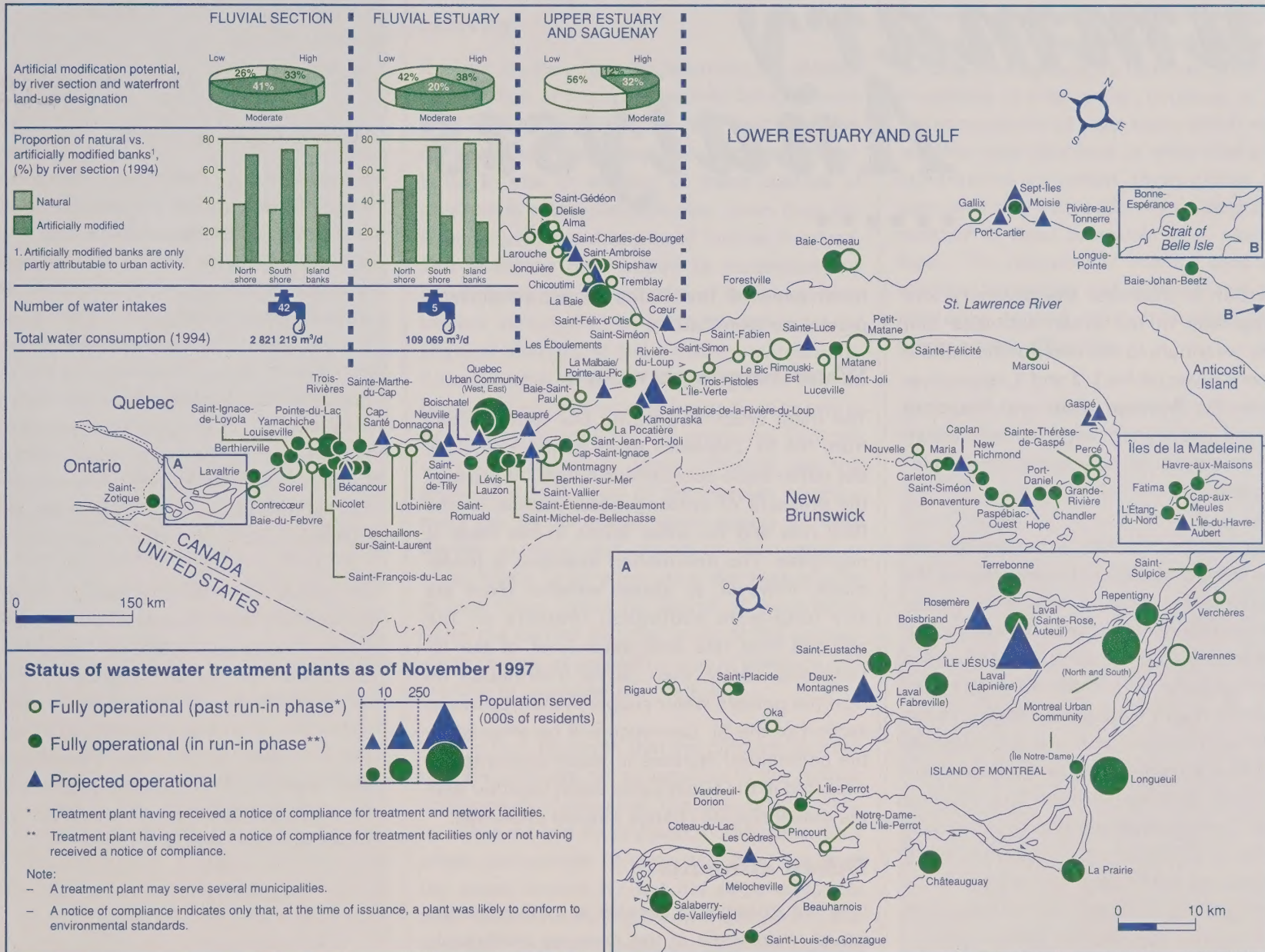
Figure 1 illustrates the geographical distribution of the pressures on the St. Lawrence River resulting from urban activity. It provides information on the status of wastewater treatment plants in Quebec relative to the population they serve and will need to serve in the future. It also highlights the population concentration and overviews problem areas. The potential for shoreline deterioration based on riverside land-use patterns indicates the significance of the modifications made to the banks, according to urbanization trends and human occupation by river section.





# The Contribution of Urban Activities to the Deterioration of the St. Lawrence River

**FIGURE 1 Main Urban Pressures and their Effects on the St. Lawrence Environment**





# Summary Analysis



**I**n order to illustrate the diversity and complexity of the urban activities that may contribute to the deterioration of the St. Lawrence River, tables 1, 2 and 3, respectively, overview the **Pressure, State and Response** components associated with various urban activities in terms of ecological and socio-economic criteria.

As shown in these tables, urbanization has generated a host of different pressures on the environment which have, in turn, affected the ecosystem components of the St. Lawrence in a multitude of ways. All the pressures associated with urban activity were analysed in terms of socio-economic and ecological criteria. These criteria were then used to relate and compare the effect of urban pressures on the state of the St. Lawrence, bearing in mind the existing measures. Some uncertainties impeded our understanding of the overall consequences of these pressures and some knowledge gaps remain to be filled. Generally, the findings and conclusions shown below were generally taken

from each of the fields of urban activity previously identified.

## Water supply services

The main effect of drawing our water supply from the St. Lawrence River is not ecological, but rather socio-economic in nature. At present, the pressure of drinking water intakes on the flow rate and on water levels in the River is negligible. The information available is inadequate, however, to assess whether there are any long-term ecological impacts on the reduced flow rate and water level of the St. Lawrence. Lastly, there is no information on how the potable water supply in the freshwater section of the St. Lawrence will be affected by the generalized increase in water consumption expected in the Great Lakes Basin together with the global climate change already underway.

## Urban effluents

It is not possible at present to determine the actual importance of the pressure attributable

## The concept of urban activity

### What is urban activity?

Urban activities derive from the phenomenon of urbanization and the concentration of human settlement, which are, in turn related to industrialization, the economy, and the development of public services, among other things. From an environmental point of view, urban activities are many and varied. They refer to the distribution of the population in towns and municipalities and to the phenomenon of urban sprawl, to the infrastructure set up to serve the populace and ensure the movement of people and goods in a given area, and to maintain certain essential public services.

In this fact sheet, the notion of urban activity has been limited to those activities which might potentially and significantly contribute to the degradation of the St. Lawrence River and its resources, and also to the attendant loss of use of the River. The issue of solid waste, then, though important, was not considered in our analysis, nor was the question of air pollution in the urban environment. ■



to urban effluents nor to determine in what proportion they contribute to the lack of recovery of some uses of the St. Lawrence River, especially water-contact activities and shellfish harvesting. It appears that the anticipated benefits of municipal water cleanup efforts were reduced by the lack of disinfection of some effluents and by sewer overflows of untreated wastewater. Furthermore, our knowledge of the concentrations of toxic substances contained in effluent released by municipal water treatment works is poor. Some indications lead us to believe that the residual toxicity of these effluents could be quite high.

## Physical modification of the riparian environment

We have no data with which to measure the wetlands lost or gained as a result of urban activity since 1976, and this prevents us from producing a portrait of the present situation or assessing short- and medium-term trends in this regard. At present, the two predominantly urban sectors (Fluvial Section and Fluvial Estuary) have been subject to progressive degradation due to urban sprawl and the appeal of the St. Lawrence for cottagers. These two river sections also happen to have the most wetland areas, the greatest diversity of plant communities and the highest number of rare priority plants. It is difficult, however, to quantify precisely such pressure on the rural and near-urban areas so degraded due to a lack of data. Knowledge gaps also exist with regard to the use of recreation and leisure areas.

## Relative importance of urban activity

It is not an easy task to determine the relative contribution of the urban activity being considered in our analysis to the deterioration of the St. Lawrence River. According greater importance to one or another of these sources of pressure is a complex exercise, given their differences and the diversity of factors involved. The available information is inadequate to assess fairly the significance of drinking water intakes versus that of effluent discharges or physical changes to the riparian environment. Consequently, socio-economic criteria cannot be ranked according to their significance owing to the varying nature of the pressures. Ecologically speaking, only urban effluents and the physical modification of the riparian environment can be compared, water supply services having no significant impact on flow rates or water levels or on other uses. We were unable to rank these issues by degree of importance given the variety and the scope of the components of state examined by type of pressure and the lack of available information.

We did find, however, that the different components of state are not as sensitive to the various components of pressure. The pressures exerted by effluents and by physical modification on a single component of state will differ because the stress factors are not the same. Effluents essentially have an impact on water quality and sediment quality, whereas physical modification

of the riparian environment directly influences wetlands, banks and biological communities. The response must therefore take these characteristics into account. In terms of effectiveness, the choice of intervention depends, in part, on the components of state upon which we opt to act. We must also bear in mind that problems considered common throughout the St. Lawrence may instead be the product of a large number of local pressures (e.g. sewer overflow). The recovery of human uses such as shellfish harvesting and water-contact activities primarily depend upon measures targeting urban-source effluents.



# The Contribution of Urban Activities to the Deterioration of the St. Lawrence River

## Pressure

Table 1 Description of Urban Pressures on the St. Lawrence Shoreline

	Water Supply Services	Urban Effluents	Physical Modification of the Riparian Environment
<b>Geographical range</b>	<p>There are 47 water intakes in the freshwater section of the St. Lawrence, 42 between Lake Saint-François and Lake Saint-Pierre (Fluvial Section) and 5 between Bécancour and Quebec City (Fluvial Estuary). None downstream of Quebec City.</p>	<p><b>Municipal wastewater</b></p> <p>In 1996, 78% of the riverside population was serviced by a wastewater treatment plant located in one of the 142 municipalities out of the 334 bordering the St. Lawrence River. However, 16% of the riverside population continued to discharge untreated wastewater to the River.</p> <p><b>Sewer overflow</b></p> <p>Although sewer overflows appear to be the source of the bacterial contamination of urbanized St. Lawrence riverbanks, overflow sites have not been inventoried.</p> <p><b>Snow dumping</b></p> <p>In 1996, 68 municipalities were still dumping snow into the St. Lawrence and its tributaries. This practice has been prohibited in all but the most exceptional cases since November, 1997.</p>	<p>In 1995, 4 186 155 people lived along the shores of the St. Lawrence, including 71.8% in the Fluvial Section. Only 13.2% of the population lived downstream of Île d'Orléans.</p> <p>In the area immediately bordering the River, designated urban land covers 164 km in the Fluvial Estuary and 107 km of the Upper Estuary/Saguenay. This corresponds to, respectively, 25%, 32% and 10.5% of the shoreline.</p> <p>The construction of road infrastructures fostered the urban sprawl of a once-concentrated population. The surface area of Metropolitan Montreal rose by 31% from 1971 to 1991, whereas the population grew by only 14%. In Quebec City, the population grew by 50% between 1961 and 1991, while the urbanized area increased by 165%.</p> <p>The extent of changes to the riverbanks is directly associated with the intensity of urbanization. This would explain the marked concentration of physical modification of banks in the Fluvial Section and Fluvial Estuary.</p>
<b>Intensity</b>	<p><b>Total daily water consumption (all categories of consumption)</b></p> <p>In 1994, an estimated 2 930 288 m<sup>3</sup> of water per day was withdrawn by 89 municipalities. About two-thirds of this water was taken from Lake Saint-Louis.</p> <p>Daily water consumption in 1994 was about 949 litres (L) per person in the case of the St. Lawrence River, compared with 650 L/person in Canada. Water consumption per person in Montreal was 1297 L, higher than in Vancouver (788 L), Quebec City (685 L), Ottawa (635 L) and Toronto (569 L).</p> <p><b>Daily domestic water consumption</b></p> <p>The fresh waters of the St. Lawrence are the source of potable water for more than 3 million people in 89 municipalities in Quebec.</p> <p>In 1994, estimated water consumption was 421 L per person, in the case of the St. Lawrence, compared to 326 L per person in all of Canada, 425 L per person in the United States, 200 L per person in the United Kingdom, and 150 L per person in France.</p>	<p><b>Municipal wastewater</b></p> <p>The Montreal Urban Community daily treats 1 875 000 m<sup>3</sup> of wastewater, or more than 1000 L per person per day, compared to between 225 and more than 380 L of wastewater per person per day for North American cities.</p> <p>Treated effluents transport a large residual load of toxic substances. However, this problem requires further study.</p> <p><b>Sewer overflow</b></p> <p>Sewer overflows lead to the discharge of wastewater which has undergone no treatment. There were more than an estimated 2000 such episodes in 1995 in Quebec. Their frequency varies considerably. Forty-six such episodes have been recorded in the Saint-Charles River basin (Quebec City) in summer.</p> <p><b>Runoff water</b></p> <p>The intensity of this pressure is not known.</p> <p><b>Snow dumping</b></p> <p>The volume of snow dumped annually into the St. Lawrence is not known.</p>	<p>The degradation of riverbanks has kept pace with the rate of urbanization and population sprawl. The size of urban areas in the regions of Montreal, Trois-Rivières and Quebec City has increased at a faster rate than has the population.</p> <p>The loss of riparian wetlands in favour of various human activities was especially marked between 1945 and 1976. Some 57% of these activities are linked to urbanization or human settlement. The loss of riparian wetlands was greatest from 1945 to 1960. The stretch from Cornwall, Ontario to Grondines, Quebec was the most affected by encroachment, with 72% of the total area lost. The rate of encroachment on the riparian environment has been poorly documented since 1976.</p> <p>The number of residents per hectare of wetlands is an indicator of the potential pressure on wetlands. This indicator is, respectively, 63 and 68 residents/ha in the Fluvial Section and Fluvial Estuary, rising to 22 and 30 residents/ha in the two downstream sectors (Upper Estuary/Saguenay and Lower Estuary/Gulf).</p>



# The Contribution of Urban Activities to the Deterioration of the St. Lawrence River

Pressure

## Water Supply Services

## Urban Effluents

## Physical Modification of the Riparian Environment

### Temporal trends

Water consumption in the Great Lakes basin is expected to increase before the year 2030. This, combined with global warming, could contribute to significantly reducing the flow rate of the St. Lawrence River. In terms of flow rate, our consumption of water from the St. Lawrence will thus exceed our present rate of 0.2%.

As water meters appear to have considerable influence on Quebec households, we can foresee a reduction in future water consumption rates.

### Municipal wastewater

In 1978, only 2% of Quebec municipalities were connected to a wastewater treatment system. In the year 2000, 98% of the population of Quebec will be served by a sewer network connected to a treatment system.

### Sewer overflow and runoff water

There is no information available.

### Snow dumping

Snow dumping into the St. Lawrence River has been restricted to exceptional cases since November 1997.

The effects of snow dumping on the St. Lawrence will only be known in the years to come.

### Population

If the current trend continues, we foresee that the population of Quebec will continue to grow until 2021, especially in regions of the Fluvial Estuary (more than 20%) and more moderately in the Fluvial Estuary (less than 20%). The population rate will fall in all areas downstream of the Fluvial Estuary.

### Potential degradation by riparian land use

The Fluvial Section and the Fluvial Estuary are the areas with the highest potential for degradation. In the former, 33% of riverbanks are at high risk (urban and industrial development) and 41% are at moderate risk (parks, recreation and cottages); in the Fluvial Estuary, the numbers are 38% and 20%, respectively. As riparian land-use patterns in the Fluvial Estuary reflect future local and regional development trends, riverbanks designated as park, recreation or cottage areas can be expected to come under increasing pressure. This may lead to ever further degradation of the banks.

We have also noted a trend to convert cottaging areas bordering major urban centres (Montreal, Trois-Rivières and Quebec City) into permanent residential districts, thereby favouring urban sprawl and the steady degradation of these environments.

### Socio-economic impact

At present, the real effect of water supply services is felt at the socio-economical level, since high water consumption is likely to lead to elevated costs for the construction and maintenance of municipal water supply and distribution infrastructures.

Charging for water may be a way of financing municipal water services.

The pressures caused by all the different urban effluents have led to the loss of many uses of the River. While the total socio-economic value of the lost uses has not been quantified, cleanup programs with a total dollar value of close to \$7 billion have been deemed necessary.

The recreational and tourist infrastructures that most degrade the environment (marinas, wharfs, launching ramps) are distributed primarily at either end of the St. Lawrence. Close to 40% of them are located in the Fluvial Section and 33% in the Lower Estuary and Gulf. Increased demand for such riverside infrastructures by the population downstream of Quebec City may have an impact on municipal zoning and on investments in such infrastructures. Moreover, such work may, in some cases, run counter to the conservation objectives of natural environments.

It is costly to protect riverbanks from erosion once urban activity has begun in a given area, and governments are forced to prioritize the banks in terms of urgency.

As for urban development, the land that borders a water body is generally the most desired and the first to be developed for residential purposes.

### Comments

- Unlike industrial-source pollution, whose effects are primarily evident on aquatic biota and habitats, urban-source pollution mainly compromises human activities such as shellfish harvesting, water sports, swimming, etc. The difference is largely due to the presence of large concentrations of micro-organisms in urban effluent.
- The riparian environment is composed of the shore area, that part of the bed of a water body extending from the lower limit of submerged aquatic plants to the high water line, and the bank, that is, the immediate land area (dry riparian environment).
- Urbanization is not a leading cause of riverbank erosion. However, deforestation due to human activity does contribute directly to bank erosion by removing the protective plant cover. Acute erosion of riverbanks requires the construction of protective structures, which, in turn, leads to greater degradation of the bank.
- Waterfront land-use patterns have a prime role in protecting riparian environments by determining the orientation of future local and regional development.



# The Contribution of Urban Activities to the Deterioration of the St. Lawrence River

**Table 2 The Effects of Urban Pressures on the St. Lawrence Shoreline**

*State*

	Water Supply Services	Urban Effluents	Physical Modification of the Riparian Environment
<b>Water quality</b>	The withdrawal of water has no effect on the water quality of the St. Lawrence River.	Overall, urban effluents do affect water quality. We have observed an improvement in the water quality for several physico-chemical parameters, which can be attributed to a reduction in contaminant discharges following wastewater treatment. However, the concentrations of certain parameters continue to exceed the quality criteria relative to use and the protection of aquatic life at some sites.	The erosion of riverbanks due to the destabilizing effect of human activities may increase the concentration of suspended matter in the water for a long time.
<b>Flow rate and water level</b>	The amount of water consumed daily corresponds to some 0.2% of the mean annual flow rate of the St. Lawrence River at Lachine. Although the amount of water consumed is generally higher during low-water periods (lawn watering, car washing, swimming pools, etc. in summer), significant declines in water levels are negligible.	No discernible effect on flow rate or water level is caused by the discharge of urban effluents to the River.	The modification of riverbanks has a negligible effect on flow rate and water level.
<b>Sediment quality and quantity</b>	No impact.	Urban effluent contributes less than 2% to the sediment budget of the St. Lawrence. We suspect that effluents contribute to the contamination of sediments by toxic substances.	The contribution of physical modification of the banks to the phenomenon of bank erosion in the St. Lawrence is not known. We do know, however, that modification of the flow pattern can influence the soil in certain sensitive areas.
<b>Impact on biological communities</b>	No major impact.	We do not know what effect the presence of toxic substances or physico-chemical parameters have on changes in the condition of aquatic organisms. Available indicators vary from one species to another and cannot be associated with urban effluent alone. However, in the case of physico-chemical parameters, criteria relative to the protection of aquatic life are increasingly being respected, with the exception of phosphorus, for which exceedances are still frequent.	The modification of banks for urban expansion may mean the loss of habitats, including wetlands. This, in turn, results in new pressures on the biological communities that live there, affecting biodiversity.
<b>Impact on human use</b>	No impact.	Although the reduction in bacterial contamination has improved the overall quality of St. Lawrence waters, there is no evidence of a significant recovery of uses (swimming and other water-contact activities). Elevated concentrations of fecal coliforms in several different urban effluents render many sites unfit for water-contact activities and shellfish harvesting. It has also been observed that the criteria relative to raw water supply (e.g. fecal coliforms) has been exceeded.	In all areas of the St. Lawrence, we have witnessed a willingness to reclaim vacant land or waterfront areas formerly used by industry for purposes of recreation and tourism. This has led, locally and regionally, to bicycle paths and ribbon parks bordering the River, among other things.



# The Contribution of Urban Activities to the Deterioration of the St. Lawrence River

*State*

	Water Supply Services	Urban Effluents	Physical Modification of the Riparian Environment
<b>Impact on riverbanks</b>	No impact.	The impacts of urban effluent can generally still be seen on the riverbanks today. Sewer overflows, in particular, may cause aquatic plants to proliferate under certain conditions.	<p><b>Dry riparian environments</b></p> <p>Based on remote sensing data from 1990-91, only 10% of dry riparian environments in the Fluvial Section and 22% in the Fluvial Estuary are still in their natural state.</p> <p><b>Natural and degraded banks</b></p> <p>The proportion of degraded banks drops heading downstream. In 1994, 47% of the banks in the Fluvial Section and 39% in the Fluvial Estuary were degraded; that is, concealed by conventional erosion-protection structures: wall, riprap, fill.</p> <p>The proportion of banks currently being developed (presence of residential areas, wharfs and any other built structure) also declines moving downstream.</p> <p><b>Shore erosion</b></p> <p>In the Fluvial Section and Fluvial Estuary, almost half of the natural banks (399 of 848 km) were eroding in 1994. Thus, only 449 km of stable natural banks, or 29% of the 1532 km of shoreline inventoried between Cornwall and Île d'Orléans, has not been modified in some way.</p>
<b>Wetlands</b>	No impact.	Though phosphorus accelerates eutrophication and, consequently, causes wetlands to dry up, we do not at present know what effect urban effluent has on the wetlands of the St. Lawrence.	Between 1989 and 1994, 78 337 ha of wetlands were inventoried along the St. Lawrence, including 73% in the two most urbanized sectors of the River (Fluvial Section and Fluvial Estuary). Eighty-seven percent of the population of Quebec live in these areas, which have also experienced the greatest losses of wetland areas.

## Comments

- Because of weather and hydrodynamic conditions, the quality criteria for swimming may be exceeded for up to three days in an environment affected by a sewer overflow, depending on the hydrologic conditions.
- The overall impact of urban discharges on the St. Lawrence food chain is not very well documented. On the one hand, we suspect that the presence of a large quantity of nutrients contributes to the development of primary biomass, but, on the other hand, we are concerned about the bioaccumulation of toxic substances by these organisms.
- The various studies that have been done on the condition of St. Lawrence riverbanks differ in their methodology and even in the area covered. Regardless, they all reported the same trends and identify the Fluvial Section and Fluvial Estuary as the two sectors of the St. Lawrence with the most degraded banks.

Wetlands are not only more widespread, but they are also more diversified in these two river sections. The majority of rare plant communities, for instance, are found in the Fluvial Section. And both the Fluvial Section and the Fluvial Estuary contain the greatest number of species and rare priority plants in the St. Lawrence system.



**Table 3 Ongoing Initiatives Relative to Urban Activities on the St. Lawrence Shoreline**

**Response**

	Water Supply Services	Urban Effluents	Physical Modification of the Riparian Environment
<p><b>Existing management measures</b></p>	<p><b>Technological advances</b></p> <p>Various water-saving devices are now available to help reduce consumption: low-flow faucets installed on taps and showerheads, and low-flow toilets.</p> <p>Some landscapers now use low-consumption watering equipment.</p> <p>Improved car-washing methods have also been developed.</p> <p><b>Societal measures</b></p> <p>Several municipalities have implemented certain restrictions on lawn watering.</p> <p>Public information and awareness programs have also been launched.</p> <p>Lastly, some municipalities have already started charging for water consumed.</p>	<p><b>Cleanup programs</b></p> <p>Since 1978, the Ministère de l'Environnement et de la Faune (MEF) and the Ministère des Affaires Municipales (MAM) have administered two successive water cleanup programs, the Programme d'Assainissement des Eaux du Québec (PAEQ) and the Programme d'Assainissement des Eaux Municipales du Québec (PADEM). The former resulted in increasing the proportion of effluent treated before discharge to the St. Lawrence River from 2% to 81% for all municipalities with a sewer system. By the year 2000, a projected 98% of municipal wastewater will be treated, thanks to PADEM. Moreover, since 1990, the MEF and the MAM have been monitoring the effectiveness of treatment works and the recovery of use of the River and its habitats.</p> <p>Regulations governing the substances discharged by municipal sewer systems have also been adopted by a large number of municipalities.</p> <p><b>Reduced sewer overflow</b></p> <p>Attempts have been made in many areas sensitive to sewer overflow to reduce their frequency, either through the design of new interception systems or flow-management measures.</p> <p><b>Runoff water</b></p> <p>There has been no specific response to the problem of the contamination of the natural environment by urban runoff water, essentially because the importance of this pressure is unknown.</p> <p><b>Policy on snow dumping</b></p> <p>Snow dumping into the St. Lawrence has only been allowed under exceptional circumstances.</p>	<p>Existing acts and regulations are intended to improve land planning and control certain activities in certain well defined areas. A policy on the protection of riverbanks, shore areas and floodplains was introduced in 1987 and revised in 1996. The new policy will be gradually incorporated into revised Regional County Municipality (RCM) development plans and into the urban planning regulations of municipalities.</p>



# The Contribution of Urban Activities to the Deterioration of the St. Lawrence River

*Response*

## Effectiveness of management measures

### Water Supply Services

#### Water pricing

Thirty percent of the municipalities that draw their water supply from the St. Lawrence charge consumers on a by-volume basis (water meters). This system serves as an economic incentive to reduce water consumption. In fact, in 1994, those Quebec homes with water meters consumed 694 L of water per person per day, or 26% less than households paying a fixed rate (942 L per person per day). The use of water meters would thus appear to be an incentive to save water.

### Urban Effluents

The treatment of wastewater discharges does appear to have improved the physico-chemical quality of St. Lawrence River water. However, the lack of disinfection of certain effluents, along with sewer overflows, serve to maintain the bacterial contamination of the water, especially on the riverbanks, to the point where uses have not been recovered to the degree anticipated.

#### Snow dumping

The effects of snow dumping will only be seen in the years to come.

### Physical Modification of the Riparian Environment

Since the implementation of management measures, we have observed a slowdown in the degradation and modification of riparian environments. However, we cannot with any certainty link this state of affairs with any one measure more than another. It is much more difficult than it was in the past, even illegal, to alter riparian environments in a unilateral fashion without authorization and without prior consultation of local and regional populations. The management measures have allowed greater local and regional involvement relative to waterfront development.

In 1997, there were 329 protected sites along the St. Lawrence, for a total surface area of 326 184 hectares (ha). These areas are managed by various levels of government and also by the private sector, in some cases. The Fluvial Section and Fluvial Estuary have the least amount of protected areas with, respectively, 21 525 ha and 19 085 ha. Major protective measures have been implemented as part of the St. Lawrence Action Plan and St. Lawrence Vision 2000. In March 1996, close to 10 000 ha of natural areas associated with the St. Lawrence had been protected since 1988.

## Perception of the population and other stakeholders (social importance)

There is no problem with respect to quantity for those getting their water supply from the St. Lawrence; the problem is quality. In fact, we have observed a lack of public confidence in the distribution networks and the quality of treatment. Many residents now eschew tap water in favour of bottled water. Indeed, the consumption of bottled water in Quebec was assessed at 38.9 L per person per day in 1994, a clear illustration of the public's distaste for drinking water drawn from the St. Lawrence.

Although the water quality in some areas of the St. Lawrence respects the criteria for swimming and water-contact activities, many citizens still consider the water polluted and unfit for swimming. In fact, many citizens erroneously think that water containing toxic substances is unfit for any use, including water-contact activities.

What we value the most in a riparian environment is its accessibility, its visual appeal, and the possibility of carrying out a waterfront activity in an adequate fashion. The public wants ever more access to the St. Lawrence for leisure activities, which may lead to the creation of new parks. However, problems arising from a lack of respect for the riparian environment, through activities which disrupt ecologically sensitive environments (e.g. sea-doo's or all-terrain vehicles), may also contribute directly to degrading the integrity of the riparian environment we are trying to preserve.

## Comments

- By charging user fees for water on a by-volume basis, municipalities may be helping to reduce consumption.
- Other means may also help to reduce municipal water consumption (e.g. adopting regulations on the installation of water-saving devices in all new constructions or renovated buildings, publicizing the water-saving efforts of commercial or industrial users; detecting leaks in the intake network, etc.).
- Considerable effort has gone into reducing urban-source pollution in the St. Lawrence River and its tributaries. In the wake of these major investments, uses have not been recovered to the degree hoped for,

primarily owing to municipal sewer overflows during rainy weather and inputs of other poorly understood sources. Urban runoff water and agricultural-source effluent are among these sources.

- The protection of natural wetland environments may prove to be a primordial factor in the long-term conservation of habitats in intensely-populated areas of the St. Lawrence or those areas susceptible to high demographic growth in the next few decades (i.e. the Fluvial Section and Fluvial Estuary).

Many people are unaware that by deforesting and degrading the banks of a watercourse, they are contributing to erosion and to the loss of many riparian environments that are important to species productivity and biodiversity. Many people are not familiar with the natural means by which they can control erosion of the banks bordering their properties.



# Taking Action



Using the principles of sustainable development as a guide, environmental objectives<sup>1</sup> must be set for those urban activities having an impact on the state of the St. Lawrence, in order to safeguard and maintain or recover uses associated with the River.

## Water supply services

No environmental objective has yet been established relative to the water supply or to the withdrawal of water from the St. Lawrence River. Thresholds beyond which water intake volumes must not exceed without serious disruption to the ecosystem or to uses of the water can be envisaged. There is a link between the flow rate of the St. Lawrence and water levels in the river. As such, environmental objectives relative to water withdrawal must be established by using a more global approach to

defining objectives related to the River's water level (Robichaud and Drolet, 1998).

## Urban effluents

The goal of the environmental objectives for effluent discharges was the recovery and preservation of all uses of the St. Lawrence, taking into account that some criteria of use could not always be met locally due to technical or financial treatment constraints.

In light of the available information, we must acknowledge that this goal has only been partially reached. Some objectives were not met due to the moratorium on the use of chlorine for effluent disinfection — when disinfection was, in many cases, a part of the technical requirements needed to meet the discharge objectives. In the case of snow dumping, the environmental objective remains to halt all direct snow dumping into the St. Lawrence River.

## Physical modification of the riparian environment

Since there is a high human population living along the St. Lawrence River and on its banks, the protection of natural riparian environments is essential to conserving St. Lawrence habitats and, to a certain extent, the physical integrity of the landscape. Clearly, then, an objective for the protection of the riparian environment is desirable. Such an objective must consider the size of the area to be protected, and the length of the banks that should be excluded from physical modification or to which development restrictions could apply. Moreover, such an objective must incorporate the principle of taking into account selection criteria relative to the quality or the strategic importance of these environments.

In addition to setting environmental objectives and acquiring new knowledge, other actions can be envisaged based on the information in Table 4. It presents conclusions on the three main issues relative to urban activity. This information is separated into different categories for each urban activity that, though not exhaustive, correspond to the main fields of activity to be considered to improve the current situation.

1. An environmental objective is a marker, a threshold or a target relating to a human activity, or to a pressure generated by a human activity, or to an ecosystem component affected by this pressure. The aim of such an objective is to maintain a human activity at a level whereby no serious or irreversible effects are observed on ecosystems; to reduce or limit such pressure to an acceptable level for ecosystems and their associated uses; and to protect, reclaim or restore these ecosystems.



**Table 4 Specific Conclusions and Fields of Activity for the Main Urban Activities Contributing to the Deterioration of the St. Lawrence River**

Water Supply Services	Urban Effluents
<p><b>Public Education and Sensitization</b></p> <ul style="list-style-type: none"> <li>• Efforts to education and sensitize consumers vary from one municipality to another or are completely non-existent.</li> </ul> <p><b>Acts, Regulation and Monitoring</b></p> <ul style="list-style-type: none"> <li>• Few municipalities distribute water-saving devices for taps, toilets or shower-heads.</li> <li>• Few municipalities have adopted regulations on lawn watering.</li> <li>• No regulation exists on the installation of water-saving equipment in either new or renovated buildings, nor on publicizing the water-saving efforts of commercial or industrial water users.</li> <li>• Few municipalities have programs to search for or repair leaks to the supply network nor do they have public-awareness programs on saving water.</li> </ul> <p><b>Municipal Water Pricing</b></p> <ul style="list-style-type: none"> <li>• Quebec households paying for water consumed on a by-volume basis consume 26% less water than households paying a fixed rate which does not take into account the quantity consumed.</li> <li>• Only 30% of riverside municipalities that draw their water from the St. Lawrence charge for water consumed (water meters).</li> <li>• Only 17% of residents of riverside municipalities have water meters.</li> </ul> <p><b>Research and Knowledge-Acquisition Activities</b></p> <ul style="list-style-type: none"> <li>• The data used offer an imprecise assessment of water consumption from the St. Lawrence River since they represent estimates of water consumption.</li> <li>• The withdrawal of water from the St. Lawrence currently has a negligible effect on its flow rate and water level. Should water consumption in Quebec increase, we do not know the level at which withdrawals will have a major effect on the St. Lawrence flow rate and water level, nor do we know how other ecosystem components and uses of the St. Lawrence would be affected.</li> <li>• We do not know what the possible impacts would be on Quebec's drinking water supply from the St. Lawrence should the flow rate and water level in the St. Lawrence drop due to climate change and increased water consumption in the Great Lakes Basin. Also, we do not know what constitutes an acceptable water intake volume in order to avoid a major impact on the ecosystem.</li> </ul>	<p><b>Public Education and Sensitization</b></p> <ul style="list-style-type: none"> <li>• Few efforts have gone into public education and awareness campaigns on the problem of urban effluent up to now. American efforts in this area have reduced releases of toxic substances to sewer networks and waste of all kinds to storm sewers.</li> </ul> <p><b>Acts, Regulations and Monitoring</b></p> <ul style="list-style-type: none"> <li>• Some discharge objectives have not been reached due to the lack of disinfection of some municipal effluents.</li> <li>• There are few means available to set up and pursue more precise discharge objectives for sewer overflow and runoff water to help minimize their negative effects on attainment of wastewater cleanup objectives.</li> <li>• A policy has been implemented to halt snow dumping in the St. Lawrence.</li> </ul> <p><b>Recovery and Restoration Activities</b></p> <ul style="list-style-type: none"> <li>• To recover use of the St. Lawrence, sewer overflow and runoff water must be taken into account, as must the effluent discharged by wastewater treatment plants.</li> </ul> <p><b>Research and Knowledge-Acquisition Activities</b></p> <ul style="list-style-type: none"> <li>• Available information is inadequate to assess completely the extent to which municipal cleanup works attain their discharge objectives in the St. Lawrence River.</li> <li>• The significance and scope of sewer overflow and runoff water, and the characteristics of these effluents and their effects on the St. Lawrence are all poorly documented.</li> <li>• Available information on water quality and the use of the St. Lawrence is not adequate enough and cannot be used to assess the true effects of effluent on use, especially human uses sensitive to poor water quality.</li> <li>• Knowledge of the toxicity of municipal effluent is still inadequate to assess the effectiveness of municipal wastewater treatment. Research is currently underway to assess this toxicity and the need to reduce it.</li> <li>• Technological advances have increased the technical and financial feasibility of disinfection processes.</li> </ul>



Table 4 (continued)

## Physical Modification of the Riparian Environment

### Public Education and Sensitization

- Riverside municipalities, real estate developers, users and the public know very little about the problems created by modification of the riparian environment or the mitigation measures that could be applied.

### Environmental Monitoring and Management of Bank Development

- The mechanisms in place are inadequate in monitoring the state of the riparian environment.
- The lack of co-operation among St. Lawrence riverside municipalities creates problems for decision makers who want a more complete picture of the needs of the population. This is particularly true with regard to reconciling enhancement and accessibility of the River with conservation.
- Incentives to limit urban sprawl and better control urban growth along the banks of the St. Lawrence should be considered.

### Acts and Regulations

- There are many legal means to control development on the banks. Maximization of all the legal instruments available is not necessarily assured due to a lack of co-operation among land-use planners, however.

### Restoration and Conservation of the Riparian Environment

- The information available does not allow precise monitoring of the changes to municipal and Regional County Municipality (RCM) waterfront land-use designations, or of the projects that could potentially modify the natural banks.
- Ecological engineering techniques have been developed for the restoration of eroding natural banks; intervention zones remain to be identified based on criteria relative to ecological, heritage or economic value.
- At present, the two sectors with the highest riverside population (the Fluvial Section and Fluvial Estuary) have the least protected areas, even though they have the greatest diversity of plant communities and the highest number of rare priority plants.
- There are few compensatory mechanisms in case of habitat loss.

### Research and Knowledge-Acquisition Activities

- Recent habitat losses due to expansion of the urban area are poorly understood; there is no monitoring network for the wetlands of the St. Lawrence.
- The rate of encroachment on the banks of the St. Lawrence, in terms of uses (industry, dwelling, cottage, recreational facilities, agriculture, etc.) is poorly understood.
- Knowledge of bank erosion downstream of Île d'Orléans due to urban activities, mainly in the Upper Estuary and Lower Estuary, is inadequate.
- Knowledge on establishing criteria to prioritize eroding riparian segments and those in need of restoration, in terms of biological, heritage and economic value, and the environmental stresses attributable to urban activity is incomplete.
- The main factors of erosion (wind waves, wake waves, water levels, etc.) and their respective roles in this phenomenon are not well documented; the role of urban activity in this regard is poorly understood.
- There are knowledge gaps as to the exact length of protected riverbanks along the St. Lawrence (e.g. parks, ecological reserves) in each river section, and their degree of protection; by combining such information with information on the state of these banks (i.e. eroding, stable, man-made or natural), we could better identify the effect of intervention work relative to the pressure caused by urban activity. Research into low-cost bank stabilization methods, in partnership with riverside municipalities, is inadequate; few municipalities are aware of the problem of erosion.
- Few data exist on the extent to which recreational and tourist facilities (marinas, wharfs, parks, etc.) are used, so it is not possible to assess the pressure exerted by such activities on the banks of the River.



# The Contribution of Urban Activities to the Deterioration of the St. Lawrence River

## For more information

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# *The State of the St. Lawrence River*

St. Lawrence Vision 2000 is an action plan governed by a cooperation agreement between the governments of Canada and Quebec. Its aim is to conserve, protect and enhance the St. Lawrence River, with the ultimate goal of returning use of the river to the population. One of the objectives of the action plan is to improve our knowledge of the St. Lawrence River and to disseminate this information to decision makers, riverside communities and the general public.

This approach is reflected in the fact sheets in the series ***The State of the St. Lawrence River***. Its main objective is to collect relevant information about the state of the St. Lawrence in Quebec to provide decision support. The focus is on a series of issues, which are interpreted according to a "pressure-state-response" approach. This approach seeks to identify causal links among the various sources of pressure exerted on the St. Lawrence ecosystem, including natural disasters and human activities, and the state of habitats and resources, and to examine measures taken to counter their effects (existing responses). Each of these environmental issues is the subject of a fact sheet intended for decision makers and those members of the general public for whom the welfare of the St. Lawrence River is a concern. ■



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*Erratum*

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